of energy than are the simple stomached animals. A large part of the difficulty lies in our inability to balance rations for the microorganisms living in the rumen. Recent research results suggest that the relative proportions of fatty acids produced in the rumen and which are available for the host animal can be varied by altering the composition of rations. Thus it is feasible to assume that a certain proportion of fatty acids will produce milk more efficiently while another proportion of fatty acids will produce fat or growth more efficiently. If these can be worked out, we shall be able to "tailor make" our rations for a given function and improve the efficiencies of these animals.

f. Discovery and classification of antimetabolites contained in feeds for ruminants. Knowledge of this nature might explain why certain forages produce poorer growth than others. Also, there might be ways of economically removing or counteracting these compounds which directly interfere with the metabolism of certain nutrients.

g. Basic discoveries of metabolic roles of nutrients in the body. When all the metabolic functions of a nutrient are established, research workers will be able to study factors affecting these functions. From studies with whole animals, we know that certain nutrient imbalances do affect growth of the animals. But we do not know how too much of one nutrient affects a specific metabolic function of another nutrient. With such information on all nutrients it might be possible to integrate this knowledge and to eventually compound a perfectly balanced ration.

In this space age, our attentions are constantly drawn to future exciting adventures out beyond the earth. No less exciting will be the new discoveries and developments in animal nutrition. As these discoveries are made and are put to use by the animal production men, our collective goal of producing more meat, milk and eggs that will sell for a price which both the producer and consumer can afford will come nearer to full realization.

Management Practices to Increase the Lamb Crop from Spring Bred Ewes

JOE V. WHITEMAN AND RICHARD PITTMAN

Most commercial lamb producers in Oklahoma try to produce and sell "spring" lambs. This system of production involves breeding the ewes so that most of the lambs are born in the fall. There are several advantages to managing the sheep flock in this manner.

1. The lambing season can be timed to come when the sheepman has the necessary time to care for the ewes.

2. Fall, winter and spring small grain pasture can be very profitably used.
3. No lambs are on the farm during the season of parasite losses.
4. Lambs are grown and fattened during cool weather.
5. The lambs are ready for market when prices are at a seasonal high.

The principal disadvantage to this system of production is that sheepmen have difficulty in obtaining a high percentage lamb crop during a short period of time.

To overcome this difficulty, sheep producers have generally used one or the other of two systems of breeding the ewes. The first system is illustrated in Figure 1. The breeding season starts usually in early April and ends in late June. The lambing season thus extends from September to sometime in November. The lambing season will last 60 to 90 days depending upon the length of the breeding season. Handling the flock in this manner will yield a good lamb crop in most years. Most of the ewes (if of predominately Rambouillet breeding) will breed and most rams are fairly fertile and active during this season. Three serious drawbacks to this system are: 1/ inefficient use of labor during a lambing season that is this long; 2/ good gaining lambs born in September and early October will reach market weight too early to bring the best price in most years; and 3/ too many of the lambs will be requiring the most feed during December, January and early February when winter pasture is in shortest supply.

The second solution that is being used to get a high percentage lamb crop is illustrated in Figure 2. Under this system of production, the breeding season starts in May or as late as early June and extends

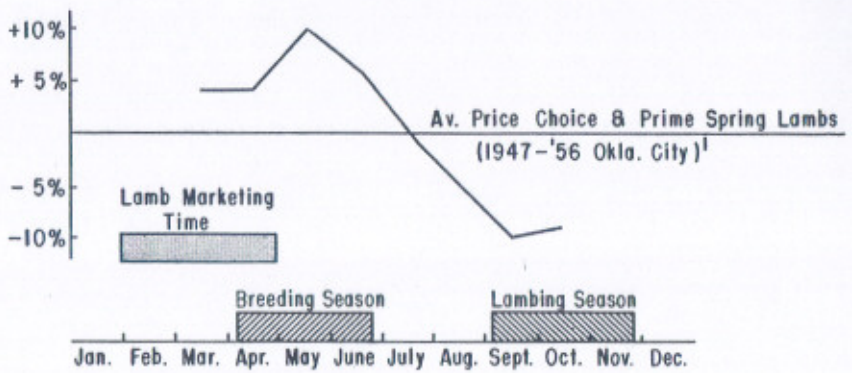

Figure 1. The breeding and lambing seasons if one is trying for all fall lambs. (Note the relationship of probable lamb marketing time to average price of lambs.)

1. Badger, Daniel D. 1958 Economic analysis of alternative sheep enterprises in Oklahoma. M.S. Thesis, Oklahoma State University.

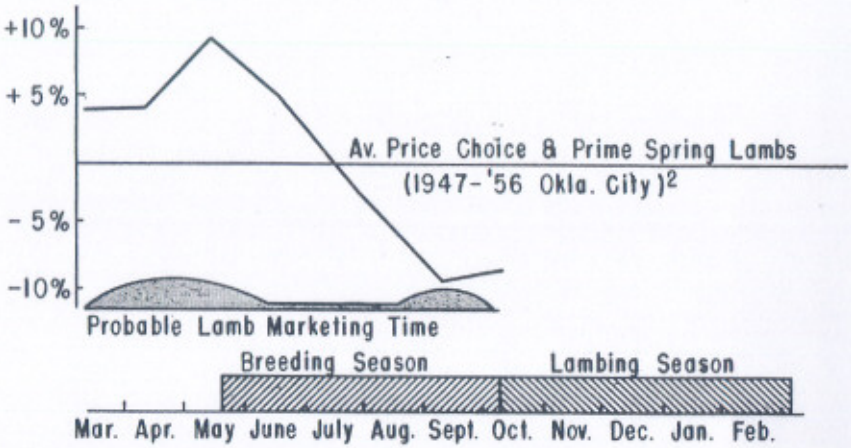

Figure 2. The breeding and lambing seasons if one starts breeding in late spring and continues until lambing time. (Note the relationship of probable lamb market time to average price of lambs.)

to early fall. The lambing season extends from sometime in October until as late as March. This system, too, will result in a good lamb crop. Depending upon the year to some extent, generally 40 to 70 per cent of the ewes will lamb in October and November, a few lambs will be born in December and January and most of the rest of the ewes will lamb in February and March. This system also has disadvantages. Again, the lambing season is too long for efficient use of labor. More serious, however, is the problem that arises as a result of the lambs born in February and March. Only the fastest gaining of these lambs will reach market weight by early June at which time the market is declining. Slow gaining lambs must be sold at light weights or additional management practices applied to prevent losses to parasites and heat. Further, ewes that lamb in February and March may not be ready to breed in May and June, but may become permanent fall breeders.

Table 1 illustrates the economic advantage associated with a high percentage lamb crop. If we get a 100 per cent lamb crop with 20 percent of the ewes raising twins and 20 percent dry, the average return per ewe will be about $8.05. This represents the return to the sheepman for his labor, permanent pasture, facilities and capital.

If management practices cause ten per cent more ewes to raise lambs at the same ratio of twins to singles, the return per ewe becomes $9.43. This is an increased return of 17 percent. A 20 percent increase in ewes lambing increases returns to $10.81 per ewe for a per-

2. Ibid.

Table 1.—Estimated costs, returns and profits from ewes with different production records

	Ewe raising: no lamb	one lamb	two lambs
Costs:			
Annual cost of ewe	$3.50	$3.50	$3.50
Annual cost of ram	.75	.75	.75
Feed costs:			
Ewe	7.00	8.00	9.00
Lamb(s)		5.00	11.00
Misc. costs	2.00	2.50	3.00
TOTAL	13.25	19.75	27.25
Returns:			
Value of lambs sold		21.00	42.00
Value of wool	7.50	7.00	6.50
TOTAL	7.50	28.00	48.50
Difference	—5.75	8.25	21.25

centage increase of 34 percent. Figure 3 shows the summary of these calculations.

An increased percentage lamb crop can also be obtained by getting a greater proportion of the ewes to raise twins. If, as in the first case, twenty percent of the ewes are dry but of the ewes that do lamb there is an increase of 10 percent twins, there is a 108 percent lamb crop and the return on the investment is increased by 13 percent. Results indicate that when we change management toward getting a greater percentage of the ewes to lamb, we frequently get a higher percentage of the ewes to produce twins.

The percent lamb crop is a measure of the prolificacy of the ewe flock under the conditions that exist. Most evidence from research indicates that whether a ewe twins, produces a single or produces no lamb is more apt to be determined by non-hereditary causes than by hereditary ones. This means that more improvement in percentage lamb crop can be made by improved feeding and management than by breeding. This does not mean that selecting for reproductive performance should be stopped. It does mean, however, that improvement in reproductive performance can also be attained by studying management and feeding practices and applying those that prove beneficial.

An economic study conducted by the University Department of Agricultural Economics[5] indicates that in an average year the return to the sheepman for his labor, fencing, land, risk and capital investment is about 16 percent. This is based on a lamb crop of about 97 percent. About two-thirds of the producers used in this survey sold lamb crops ranging from about 87 to 107 percent. These figures are

[5] Ibid.

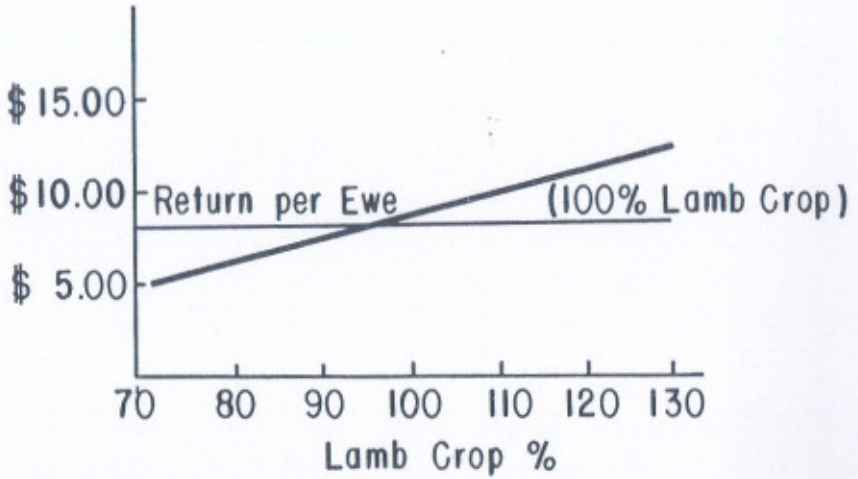

Figure 3. Estimated effect on return on investment in capital, labor, fencing, land and risk of percentage lamb crop sold.

not quoted as a criticism but as a guide so that we may know what the normal percentage lamb crop is. These figures indicate that there is considerable variation from flock to flock in ewe prolificacy as measured by percentage lamb crops sold. The reported percentage of lamb crop born averaged about 112 percent with about two-thirds of the flocks falling between 90 and 135 percent.

Research Results

Improved reproductive performance might be brought about by improvements in three general areas of breeding and management as follows:

1. Using more prolific ewes.
2. Improving ram performance.
3. Improving management so that ewes perform better.

For three years we have been studying some of these problems with a commercial ewe flock at the Ft. Reno Experiment Station, El Reno, Oklahoma. In the late spring of 1955 one hundred grade Rambouillet and one hundred ¼ Panama X ¾ Rambouillet yearling ewes were purchased to establish the flock. Dorset rams have been used on these ewes exclusively. Very briefly, the ewes are managed as follows: the breeding season has been 32 to 48 days in length, starting from May 20 to June first; lambs are born in the barn or in small lots adjacent to the barn and moved immediately into lambing pens; before leaving the lambing pens, they are paint branded and ear tagged with their mother's number and are also docked; after lambing,

the ewes with lambs go to wheat pasture; the lambs are individually weighed every two weeks and are marketed when they weigh 92 or more pounds.

The lambing performance of these two groups of ewes has been very different consistently (See Table 2). The Rambouillet ewes have shown a higher reproductive performance every year. Panamas are ½ Lincoln and ½ Rambouillet. The Lincoln breeding would have to be incriminated if this difference is due to the breeding of the ewes. The difference may be due to the management of the ewes before we obtained them. The cause of this difference in performance is not known but is being studied further. Whatever the cause, it is obvious that we cannot expect groups of purchased yearling ewes to perform the same. We need to know what to look for in the ewes we buy that will indicate good reproductive performance and how to cull the poor producers that will be present in any flock. These factors are also being studied.

Table 2.—The reproductive performance of two groups of ewes of different origin and breeding.

	¼ Panama X ¾ Rambouillet	Grade Rambouillet
1955 Results (48 day breeding season)		
Ewes lambing, %[1]	58	80
Lambs born, %	74	91
Lambs raised, %	49	77
1956 Results (48 day breeding season)		
Ewes lambing, %	80	86
Lambs born, %	102	117
Lambs raised, %	81	108
1957 Results (32 day breeding season)		
Ewes lambing, %	80	82
Lambs born, %	94	112
Lambs raised, %	86	99

[1] All percentages are based on the number of ewes in the breeding flock.

The management of the ewe may influence her performance. To study one phase of management, an experiment was conducted during the past two years to determine if the time of shearing would influence ewe productivity. One half of the ewes were shorn early in April and the other half were shorn about ten days before the breeding season began. (See Table 3 for the results.) These results are considered to be fairly conclusive proof that late shearing will improve ewe reproductive performance especially in years when the weather is hot during the breeding season. Closer observation of the data (not shown here) indicates that late shearing is more beneficial for the ewes that are part Panama than for the grade Rambouillet.

Table 3.—The effect of time of shearing on ewe performance.

	Shorn 4/7	Shorn 5/12
1956 Season (hot)		
Ewes lambing, %[1]	80	86
Lambs born, %	97	122
Lambs raised, %	84	100
1957 Season (cool)	4/6	5/22
Ewes lambing, %	78	89
Lambs born, %	102	109
Lambs raised, %	91	100

[1] All percentages are based on the number of ewes in the breeding flock.

During the three years since obtaining the ewes, we have been studying the effect of keeping one-half of the rams cool. A room in the sheep barn has been used to keep one-half of the rams from 8:00 a.m. until 5:00 p.m. daily from three weeks before the breeding season starts until it ends. An evaporative cooler (1955) or a used ½ ton refrigerated air conditioner (1956 and 1957) was used to cool the room. The maximum temperature in the room was usually 82-83° F. on hot days. The other rams were placed in a stall of similar size and lighting conditions but which was 8-12° F. warmer on hot days. The rams were turned with the ewes at about 6:00 p.m. and removed at about 7:30 a.m. The plan of the experiment was such that pairs of rams (one cooled and one not cooled) were assigned to groups of ewes and used in such a manner that each ram had an equal opportunity to sire as many lambs as his pair mate.

Table 4 gives the results from this experiment. The over-all advantage to cooling is an increase of about 27 percent in number of lambs born. However, due to the way in which the experiment was designed, this is an overestimate of the difference. There is no way to determine from our records what the true difference is but it is probably between 13 and 20 percent. The ram that has been kept in the cooler room has in every case out-performed his pair mate if we use number of lambs born as the measure of ram performance. In most instances the cooled ram has been more aggressive and also the cooled rams have usually settled a higher percentage of the ewes served.

Summary and Discussion

These results indicate that one kind of ewe has been about 24 percent more productive than another, that late shearing increased reproductive performance by 15 percent and that keeping rams from getting

Table 4.—The breeding performance of cooled and non-cooled rams

	Cooled	Non-cooled
1955 Results (2 pairs of yearling rams)		
Effective matings[1]	68	58
Known conceptions	43	32
Conception rate, %	63	55
1956 Results (4 pairs of yearling rams)		
Effective matings[1]	129	111
Known conceptions	89	72
Conception rate, %	69	65
Number lambs sired	122	91
1957 Results (2 pairs of 2-year-old rams)		
Effective matings[1]	64	46
Known conceptions	38	30
Conception rate, %	59	65
Number lambs sired	49	39

[1] Matings that could have resulted in conceptions.

hot resulted in about 15 per cent more lambs. One might want to add these figures together and say that the best combination of treatment is 54 percent better than the poorest combination. **Unfortunately this is not so.** It has already been indicated that the part Panama ewes respond more to the change in time of shearing than did the Rambouillets. For this and other reasons we cannot add these values together. The records do not permit us to make the desired calculation. A crude estimate would indicate that an increase of 25 to 35 percent in reproductive performance may be expected if we breed cooled rams to late shorn Rambouillet ewes as compared to breeding non-cooled rams to early shorn part Panama ewes. It should be remembered that we have no proof that the difference between the two groups of ewes is due to their breeding.

It is impossible for us to conduct our experiments in such a way as to duplicate any individual sheepman's conditions. We cannot say to what extent these results will apply to sheep managed differently as illustrated in Figures 1 and 2. We do believe, however, that application of one or more of these methods will improve the reproductive performance of many of the ewe flocks in Oklahoma. Those presently getting a good lamb crop may be able to shorten their breeding season and, thereby, their lambing season. Those getting lambs born in the